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## (54) POSITIONAL INFORMATION TRANSMITTING METHOD OF DIGITAL MAP

### (57)Abstract:

PROBLEM TO BE SOLVED: To allow accurate information exchange of positional information on a digital map with less data amount without being accompanied by load of maintenance.

SOLUTION: When a road position on a digital map is communicated, an information providing side transmits, as road position information, coordinate row information (st. 2) including this road position for showing a road shape of a determined length of road interval, additional information (st. 3) including at least one of road attribute information including this road position and detail information of nodes in the road interval, and relative information indicating the road position in the road interval. A receiving side of the road position information performs a shape matching (st. 12), specifies the road interval on the digital map, and specifies the road position in the road interval using the relative data (st. 13). The receiving side can accurately specify the road shape using the additional information, a transfer data amount can be reduced, and the road position can be accurately specified, even if there is less data amount of the coordinate row.



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**Notes:**

1. Untranslatable words are replaced with asterisks (\*\*\*\*).
2. Texts in the figures are not translated and shown as it is.

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**[Claim(s)]**

[Claim 1] In the position information method of communication for telling, the road position on a digital map [ the information service side ] The coordinates sequence information which shows the road form of the road section including said road position where length was determined according to the difficulty of form matching, The additional information containing at least one of the attribute information on the road including said road position, and the detailed information of the node in said road section, [ the side which transmitted the relative information which shows said road position in said road section as road position information, and received said road position information ] The position information method of communication characterized by performing form matching, pinpointing said road section on a digital map, and pinpointing the road position in said road section using said relative data.

[Claim 2] The position information method of communication according to claim 1 characterized by using the coordinates sequence information that the coordinate data in which the position of the node contained in said road section and an interpolating point is shown as said coordinates sequence information was arranged in order.

[Claim 3] The position information method of communication according to claim 2 characterized by for the contribution to form matching thinning out a low interpolating point, and generating said coordinates sequence information in the interpolating point included in said road section.

[Claim 4] The position information method of communication according to claim 3 characterized by thinning out the interpolating point that change of a direction is below a predetermined angle, and said interpolating point or the distance from a node is under predetermined distance, and generating said coordinates sequence information to an adjoining interpolating point or the adjoining direction from a node.

[Claim 5] It is the position information method of communication according to claim 2 characterized by displaying the coordinate data of one node contained in said road section, or an interpolating point by an absolute coordinate as said coordinates sequence information, and displaying the remaining nodes or the coordinate data of an interpolating point by a relative coordinate.

[Claim 6] The position information method of communication according to claim 1 characterized by including at least one information on a road classification code, a road number, a toll road code, the number of lanes, regulation information, the width of street, the number of connection links in a crossing node, and the

connection angle of the connection link in a crossing node in said additional information.

[Claim 7] The position information method of communication according to claim 6 characterized by including the accuracy information on the digital map data used for said additional information.

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#### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention is especially given the position on a digital map exactly and efficiently in the system which offers traffic information about the communication-of-information method for giving the road position information which traffic congestion, an accident, etc. have generated.

[0002]

[Description of the Prior Art] The vehicles carrying a navigation mount machine are increasing rapidly in recent years. In a mounted navigation system, a digital map database is held, based on the latitude and longitude data received by a GPS receiver, the map around a self-vehicle position can be displayed on a screen, or the path planning result to a run locus or the destination can be collectively displayed on a map.

[0003] In our country, although the database of the digital map is created at several companies now, the error is included in this map data as fate of a map on reduced scale. For example, depending on the place, the about [ 50m ] error is included also with 1/25000 of maps, and the error changes with digital maps of each company.

[0004] Moreover, several 10m error is included also in the latitude and longitude data obtained from a GPS receiver.

[0005] Moreover, in response to offer of traffic information, such as traffic congestion information and accident information, traffic congestion and an accident position are displayed on a map, or the model which carries out path planning [ on condition of those information ] is made from the navigation mount machine.

[0006] [ the traffic information offer system realized in the past ] As shown in drawing 8 , traffic information is supplied to the information distribution center 72 from the traffic information collection center 71 which has jurisdiction [ area ], and the traffic information edited into each Media (an FM broadcast, a beacon on the street, cellular phone) is transmitted through each Media.

[0007] Moreover, the traffic information collection center 71 exchanges other traffic information collection centers 78 and traffic information of an area, and collects large traffic information within the circle including a surrounding area.

[0008] In order to give [ in / this traffic information ] an accident position, when the latitude and longitude data of that position are shown independently Since it has a different error according to the kind of digital map database which the mounted vessel holds so that it may mention above, There is a possibility of identifying the position on a different road as an accident position with the mounted vessel holding the digital map database by A company and the mounted vessel holding the digital map database by B company.

[0009] In order to improve the inaccuracy of such communication of information, as shown in drawing 9 (a), make the crossings a and b of a road network into a node, consider the road c between nodes as a link, and [ each node ] The node number (a= 1111, b= 3333) which expresses the node to a meaning is set up, and

[ each link ] The link number ( $c = 11113333$ ) which expresses the link to a meaning is set up, and the node number and link number which were set to the digital map database of each company to each crossing and a road match, and are memorized.

[0010] And in traffic information, when it expresses the position on a road, a link number is specified and the point on a road is displayed with the mode of expression which it says from the head is how many meters. For example, when displayed as "the position of the head of the road of link number = 11113333 to 200m", it also sets in the mounted vessel which uses what kind of digital map data. By following a 200m point from the node of the node number 1111 of the road of the link number 11113333, it becomes possible to ask for the position P on the same road.

[0011]

[Problem to be solved by the invention] [ however, the node number or link number which were defined as the road network ] As shown in drawing 9 (b), when it will be necessary to change for a new number, and Road d is established newly, or a road is changed and a node number and a link number are changed in this way, you have to stop having to update the digital map data of each company.

[0012] Since establishment and change of a road are continuously made over the future, as long as the road locative-calls method by the node number or a link number is taken, there is a problem that quantity of work great for the maintenance of a digital map database and the expense accompanying it must be supplied permanently.

[0013] Moreover, the information on the newest fiscal year is overlapped, it is necessary to send the information which applied to a past node number and a past link number correspondingly during a fixed period (three to five years) for the navigation sold in the past, and the maintenance burden will become big in the center.

[0014] In order to improve such a point, the inventor of this invention etc. has proposed about the position information method of communication which can give the position information on a digital map, without already being accompanied by the excessive burden of a maintenance (Tokuganhei11-3063).

[0015] [ this position information method of communication ] in order that the information service side may give a road position The road form data which consists of the coordinates sequence which shows the road form of the road section of predetermined length including the road position, The relative data in which said road position in this road section is shown is transmitted, in the side which received these information, form matching is performed, the road section on a digital map is pinpointed, and the road position in this road section is pinpointed using relative data.

[0016] For example, when traffic congestion has occurred in the section of A-B of the road shown in drawing 6, the road form of the road including the section is displayed by the coordinates sequence of 600 points of a 5m interval,  $P_0 (x_0, y_0)$ ,  $P_1 (x_1, y_1)$ , --,  $P_{600} (x_{600}, y_{600})$ . Here,  $x_k$  and  $y_k$  are the latitude and longitude data of the point  $P_k$  on the road acquired from the digital map database which the information service side holds. Furthermore, the distance  $l_1$  from the point  $P_0 (x_0, y_0)$  to the traffic congestion onset point A and the distance  $l_2$  to the end point B of traffic congestion are found, and it is road form data. :  $(x_0, y_0) (x_1, y_1) \dots (x_{600}, y_{600})$

Distance data of traffic congestion: Generate  $l_1 - l_2$  m as position information. And this position information is changed into a predetermined transmission format, and it transmits to the reception side.

[0017] In the reception side which received this information, form matching with the map data of the digital map database which the reception side holds, and the received road form data is performed, and the road section on the digital map of self is pinpointed. And based on the distance data from the starting position of the road section, the traffic congestion section which should be displayed on the digital map of self is pinpointed.

[0018] Drawing 7 shows an example of this form matching.

[0019] First, the roads Q and R included in the range of the error centering on P0 (x0, y0) point of the map data read from the digital map database of self are selected as a candidate.

[0020] Subsequently, the position Q0 on each candidate road nearest to P0 (x0, y0) and R0 are calculated, and the distance between P0-Q0, P0 - R0 is computed.

[0021] This operation is asked for P1 (x1, y1), --, the road section whose aggregate value of each point P0, P1, --, a square average of the distance from P600 perform about each point of P600 (x600, y600), and serves as the minimum. 1b

[0022] Subsequently, the l1-l2m section is pinpointed as the traffic congestion section from the starting position of the road section.

[0023] Even if such a method defines neither a node number nor a link number, it enables it to pinpoint a road position by the reception side by offering the road form data which expressed road form with the coordinates sequence. This position information method of communication can be used in the case of traffic information offer from the exchange, or FM office and the beacon on the street of traffic information between traffic information collection centers.

[0024] However, by this method, in order to tell road form exactly, the position information on many points on a road must be transmitted, but there is a fault that a transmission amount of data increases very much, as that result. But in order to reduce an amount of data, when the number of road Uechi points which gives position information is reduced, there is a possibility of inviting incorrect matching by the side of reception.

[0025] This invention aims at offering the position information method of communication which can tell road form correctly with a small amount of data, when responding to such a technical problem and transmitting road form by the position information on two or more points on a road.

[0026]

[Means for solving problem] So, when giving the road position on a digital map, in this invention [ the information service side ] The coordinates sequence information which shows the road form of the road section of length according to the situation of including said road position, The additional information containing at least one of the attribute information on the road including said road position, and the detailed information of the node in said road section, The relative information which shows said road position in said road section is transmitted as road position information, and form matching is performed, and he pinpoints said road section on a digital map, and is trying to pinpoint the road position in this road section in the side which received this road position information using relative data. 1b

[0027] Thus, by transmitting additional information with coordinates sequence information, by the reception side, the data of a coordinates sequence is enabled to specify road form with high precision at least, and reduction of a transmission amount of data and pinpointing of a highly precise road position are attained.

[0028]

[Mode for carrying out the invention] In the position information method of communication in the form of operation of this invention, it transmits against road form using the information which exists in the digital map database beforehand.

[0029] As two or more points on the road which displays a coordinates sequence, the interpolating point of a node and a node included in a digital map database is used by this position information method of communication. A node is a point on the road set up corresponding to the boundary of a crossing, the entrance and exit of a tunnel, the entrance and exit of a bridge, and an administrative district etc., and an interpolating point is a point set up in order to reproduce the road form between nodes.

[0030] In drawing 2 (a), P1, P2, P3, and -- are illustrated as the node and the interpolating point on a digital map. Among this, P2 and P6 which show a crossing are a node, and others are interpolating points.

[0031] Moreover, in addition to the information on the coordinates sequence of this node and an interpolating point, in this position information method of communication, the detailed information of the road classification which exists in a digital map database beforehand, a road number, or a crossing node etc. is transmitted as additional information.

[0032] Road classification is information which has distinguished the highway, the national highway, the principal prefectural road, etc. A road number is a number given to the road like Kokudou No. 246. The number of intersection links linked to the node, the angle of the intersection link to connect, etc. are contained in the detailed information of a crossing node. The number of intersection links of the crossing node P6 of drawing 2 (a) is 2, and a connection link angle is expressed with the angle d1 between links to make, and d2. Moreover, as a connection link angle is shown in drawing 2 (b), it may be expressed as the angle d'1 from the north (dotted line) of each link, and d'2.

[0033] Moreover, in addition to this, in the case of a crossing node, a crossing name can be added, or when the node expresses the boundary of the entrance and the exit of a tunnel, the entrance and exit of a bridge, and the administrative district etc., those information can be added to additional information.

[0034] Moreover, in order to tell the standard of the accuracy of transfer information, the information which shows the accuracy level of a basis figure is added to additional information so that it may say that it is data obtained from 1/25000 of map data, or is data obtained from 1/10000 of map data.

[0035] Moreover, in this position information method of communication, the coordinates sequence of an interpolating point which the length of the node acquired from the circumference of a phenomenon position and an interpolating point coordinates sequence is changed according to the difficulty of form matching, and seldom contributes to the improvement in accuracy of form matching from a viewpoint which reduces an amount of data is thinned out.

[0036] Generally, in road density, when there are many \*\*\*\* roads, it is a reception side, and is easy to generate incorrect matching, and the difficulty of form matching becomes high highly. For this reason, when a node and an interpolating point coordinates sequence are acquired from the circumference of a phenomenon position by this position information transfer method, The road density of a phenomenon position circumference part, the existence of a \*\*\*\* road, etc. are searched, together with a map accuracy level, when it is easy to generate incorrect matching, the length of a node and an interpolating point coordinates sequence is acquired for a long time, and when it is hard to generate, it acquires short.

[0037] It is judged whether thinning processing thins out an interpolating point according to the thinning

conditions which combined distance and an angle, and, in more than  $\alpha$  (degree), a direction does not change from a front node or a front interpolating point to a direction, and only the interpolating point that the distance from a front node or a front interpolating point is under  $\beta$  (m) is thinned out.

[0038] In drawing 3 (a), the direction  $d_k$  from the interpolating point  $P_k$  is below  $\alpha$ , and since the distance  $g_k$  from the interpolating point  $P_k$  is under  $\beta$ , interpolating point  $P_{k+1}$  is thinned out. About the following interpolating point  $P_{k+2}$ , since interpolating point  $P_{k+1}$  was thinned out, it is judged whether thinning conditions are suited to direction  $d'_k$  and distance  $g'_k$  from the interpolating point  $P_k$ , and distance  $g'_k$  is under  $\beta$ , but since direction deviation  $d'_k$  becomes larger than  $\alpha$ , interpolating point  $P_{k+2}$  are not thinned out.

[0039] Moreover, in the case of drawing 3 (b), after interpolating point  $P_{k+1}$  is thinned out, direction deviation  $d'_k$  is smaller than  $\alpha$  about interpolating point  $P_{k+2}$ , but since distance  $g'_k$  becomes longer than  $\beta$ , interpolating point  $P_{k+2}$  are not thinned out.

[0040] The flow of this thinning processing is shown in drawing 4.

[ judge whether the interpolating point in front of step 22: or the direction deviation  $d_n$  with a node is smaller than  $\alpha$  to the interpolating point  $P_n$  of Step 21:  $n=1$ , and ] if small if the interpolating point in front of Step 23: or the distance  $g_n$  with a node judges whether it is short and is shorter than  $\beta$  -- step 24: -- the interpolating point  $P_n$  is thinned out.

[0041] The processing after Step 22 is repeated to step 25:, next the interpolating point  $P_n$  which incremented the value of  $n$  one time.

[0042] Moreover, it shifts to Step 25, without thinning out the interpolating point  $P_n$ , when  $d_n$  is larger than  $\alpha$  in Step 22, and when  $g_n$  is longer than  $\beta$  in Step 23.

[0043] In this way, the data image of the coordinates sequence data (node sequence information) of the node after thinning out an interpolating point, and an interpolating point, and the additional information added to it is shown in drawing 5.

[0044] For the node sequence information on drawing 5 (a), it is dealt with as a node including target node and interpolating point of a road. For this node sequence information, enter the data of the longitude of  $P_1$  position, and latitude in the coordinate value of the first node number  $P_1$ , and to it [ the coordinate value of the node number  $P_2$  from the next, --,  $P_n$  ] every -- the difference  $(x_2, y_2)$  of the data of the longitude of  $P_2$ , --,  $P_n$  position and latitude and the data of the longitude of  $P_1$  position and latitude, --,  $(x_n, y_n)$  are filled in. Thus, it becomes possible by displaying the node position of the 2nd henceforth by a relative coordinate to reduce an amount of data.

[0045] In addition, the method of there being nothing as a relative coordinate only by the method of displaying difference with the longitude of  $P_1$  position and latitude, and taking difference (if it being  $P_n$  difference of  $P_{n-1}$ ) with the data of the node in front of one is also possible, and it becomes possible by carrying out like this to reduce the amount of data of node sequence information further.

[0046] Moreover, the road classification code of the target road, the road number, and the number of crossing information showing the number of the crossing nodes contained in this additional information are displayed on the additional information of drawing 5 (b), and it is further related with a crossing node. The node number ( $P_2$ ) linked to node sequence information, the number of connection links of the crossing node ( $P_2$ ) ( $I_2$ ), the  $I$ -th of the connection link angle of the 1st connection link (1) of the crossing node ( $P_2$ ), --, its

crossing node (P2) -- the connection link angle of the 2nd connection link (l2) is displayed for every crossing node, respectively.

[0047] The road form of the predetermined road section is set up by this node sequence information and additional information, and the road position in this road section which should be pinpointed is set up with relative data.

[0048] The flow figure shows the sending end in the case of enforcing this position information method of communication, and the procedure by the side of reception to drawing 1 .

[0049] If the phenomenon position on the road which step 1: traffic congestion and an accident generated inputs a sending end Step 2 : The node around a phenomenon position and the coordinates sequence of an interpolating point are acquired from the digital map database held by a sending end. Step 3 : Additional information is acquired from the digital map database. Step 4 : Perform thinning processing of an interpolating point, express the node after thinning processing, and the coordinates sequence of an interpolating point by a relative coordinate, and node sequence information is generated. Step 5: Change into a transmission format the relative data showing the phenomenon position in the node sequence information that the road section is expressed and additional information, and the road section, and transmit as step 6: position information.

[0050] The road section which compares the data of the digital map database which will be a step 12: reception side and will be held by the reception side on the other hand if step 11: data is received, and the node sequence information and additional information which were received, performs form matching, and corresponds to the transmitted road form is pinpointed.

[0051] This form matching can be performed using the technique shown in drawing 7 mentioned above. At this time, it is possible to limit a candidate road by the road classification code and road number of additional information. moreover, when calculating the position Qk on each candidate road corresponding to the position Pk of each node number of node sequence information, and Rk and Pk is a crossing node It compares with the intersectional crossing information that it is located near Qk and the Rk, and about a conflicting road, it can remove from a candidate and can ask for the applicable road section with high precision and quickly.

[0052] Step 13: If the road section is known in this way, based on the relative data in which a phenomenon position is shown, the phenomenon position on the pinpointed road section will be decided, and a phenomenon position will be displayed on a display screen.

[0053] Thus, since additional information is transmitted [ this position information method of communication ], even if it reduces the amount of data of a coordinates sequence, it is possible to grasp the road position on a digital map exactly to the reception side.

[0054] In addition, if only what that is expressed on a digital map with a natural thing computes position information using form matching, application is possible also except traffic information. Moreover, the following directions for use are also possible for this position information method of communication.

- Use form data other than a road (house form, river form, an administration community, and contour line) with additional information, and transmit position information.
- When two or more phenomena adjoin, define two or more phenomena as one form data, and reduce the amount of information.



- How to search for the phenomenon point which defines one or more datum points on form data, expresses the phenomenon point which exists outside a road in the distance and the direction of [ from each datum point ], and is outside a road after form data matching using the above-mentioned distance and direction from the datum point which was newly able to be found.

[0055]

[Effect of the Invention] In the position information method of communication of this invention, the position on a digital map can be correctly given to the other party, without using the node number and link number of a road network so that clearly from the above explanation. Moreover, since additional information is transmitted with node sequence information, the amount of data communications for giving position information can be reduced sharply, and a position can be grasped with high precision and quickly in the reception side.

[0056] According to this method, the quantity of work and expense which are spent on the maintenance of a digital map database can be reduced sharply, and social cost required for maintenance of a traffic information offer system can be reduced.

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[Brief Description of the Drawings]

[Drawing 1] The flow figure a sending end [ which enforces the position information method of communication in the form of operation of this invention ] (a), and reception side showing the procedure of (b),

[Drawing 2] The figure (a) showing the connection link angle in the node in a position information method of communication, and the interpolating point and crossing node in the form of operation of this invention, and the figure (b) which displays a connection link angle by other methods,

[Drawing 3] The explanatory view explaining thinning processing of the interpolating point in the position information method of communication in the form of operation of this invention,

[Drawing 4] The flow figure showing the procedure of thinning processing of the transmission data in the position information method of communication in the form of operation of this invention,

[Drawing 5] The figure showing the structure of the data transmitted by the position information method of communication in the form of operation of this invention,

[Drawing 6] The explanatory view explaining the road form data and distance data which constitute the road position information on the position information method of communication proposed previously,

[Drawing 7] The explanatory view showing an example of form matching,

[Drawing 8] The explanatory view showing a traffic information offer system,

[Drawing 9] They are the explanatory view (a) of a node number and a link number, and the explanatory view (b) showing change of a node number when a road is established newly, and a link number.

[Explanations of letters or numerals]

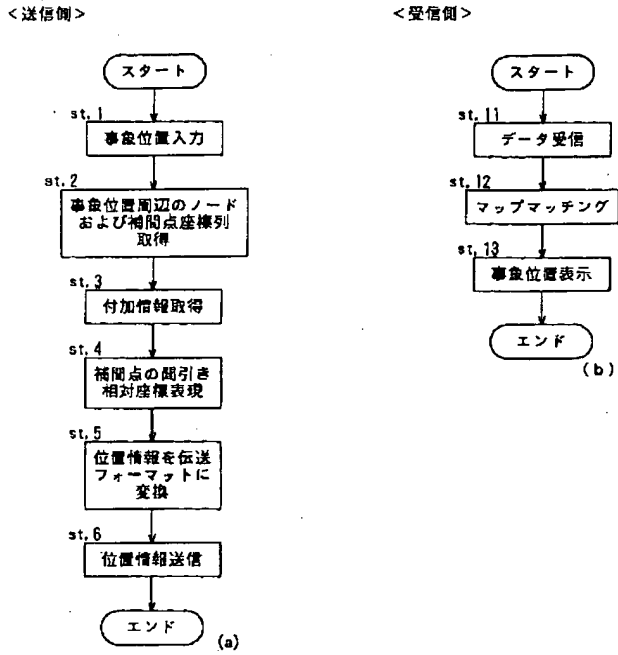
71 A Traffic Information Collection Center

72 Information Distribution Center

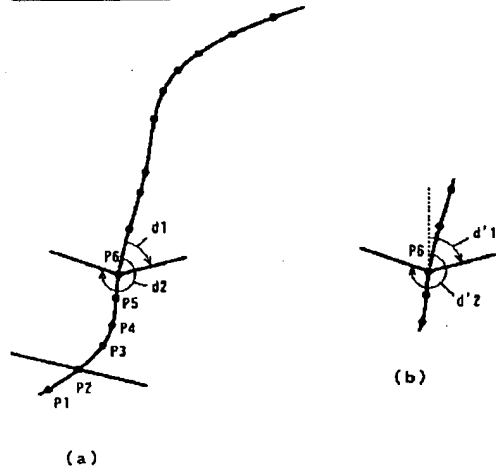
73 Media SENTA

74 FM Office  
75 Beacon  
78 B Traffic Information Collection Center

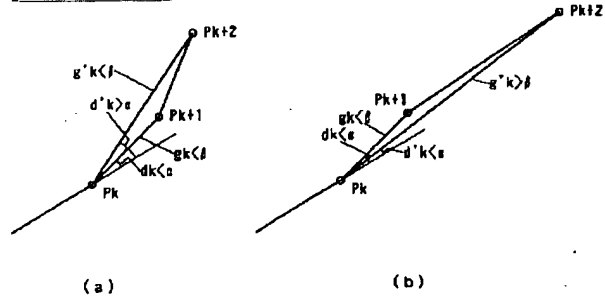
[Drawing 1]



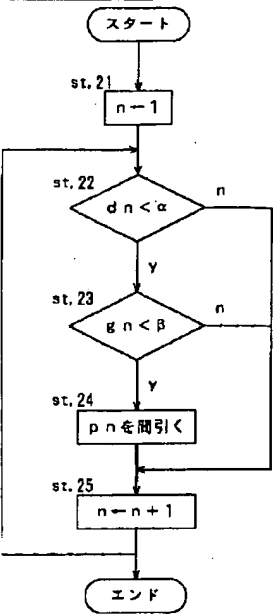
[Drawing 2]



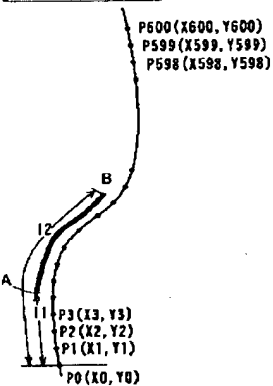
[Drawing 3]



[Drawing 4]



[Drawing 6]



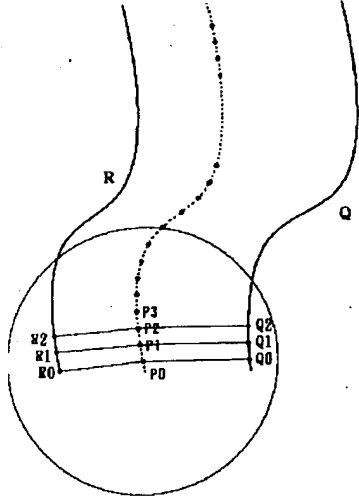
[Drawing 5]

ノード列情報		付加情報	
ノード総数 n		道路種別コード	高速道路、国道等
ノード番号 p 1		道路番号	国道 2 4 6 等
経度		交差点情報数	
緯度		ノード番号 p 2	
ノード番号 p 2		p 2 の接続リンク数 l 2	
相対座標 x 2		p 2 の接続リンク角度 1	
相対座標 y 2		}	
}		p 2 の接続リンク角度 l 2	
ノード番号 p n		ノード番号 P 6	
相対座標 x n		P 6 の接続リンク数 l 6	
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		P 6 の接続リンク角度 l 6	

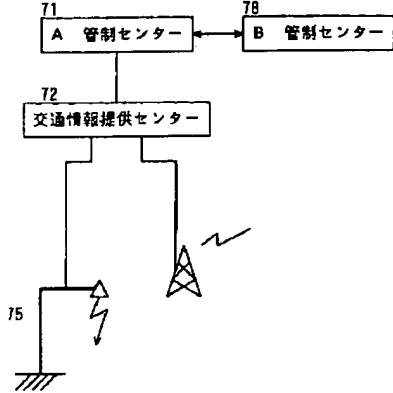
(a)

(b)

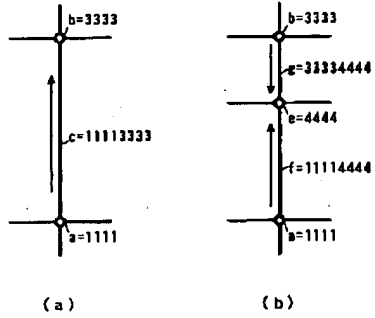
[Drawing 7]



[Drawing 8]



[Drawing 9]



[Translation done.]